REMARKS

The Office Action notes that claims 1-49 are pending in the application. The present response amends claims 1, 4, 18, 26, and 44 and adds claims 50-51. Therefore, claims 1-51 are no pending in the application. The Applicant has not added new matter through amendment.

Claims 1 and 26 have been amended to clarify that the surface-treated nanocrystalline particles that are added to the cross-linkable resin are non-aggregating. Claims 18 and 44 have been amended to clarify that the surface-treated nanocrystalline particles are dispersed in the cross-linked resin in a non-aggregating fashion. Claim 4 was amended to change its dependency from claim 1 to new claim 51. Finally, claims 50-51 are dependent claims that were added to recite a broader range of nanocrystalline particle concentration in the dispersions defined therein.

Claims 1-49 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Havey '514, Havey '163, Tao '971, Nguyen '656, Brotzman '967, and Brotzman '781 in view of Penth '657, McCulley '830, or McCulley '296.

The Office Action maintains that Havey '514, Havey '163, Tao '971, Nguyen '656, Brotzman '967, and Brotzman '781 disclose that it "is known in the art to produce a substantially transparent, abrasion resistant films [sic] comprised of a cross-linked resin and a plurality of surface-treated particles dispersed in cross-linked resin." The Office Action acknowledges that Havey '514, Havey '163, Tao '971, Nguyen '656, Brotzman '967, and Brotzman '781do not teach that the surface-treated particles should be nanocrystalline particles. The Office Action asserts, however, that Penth '657, McCulley '830, and McCulley '296 "specifically teach that "particles should be nanocrystalline particles". Therefore, the Office Action concludes it would be obvious to one of ordinary skill in the art to substitute the particles of Penth '657, McCulley

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'830, or McCulley '296 into the compositions of Havey '514, Havey '163, Tao '971, Nguyen '656, Brotzman '967, and Brotzman '781, thereby disclosing the claimed inventions. The Applicant respectfully submits that the Office Action fails to establish the obviousness of pending claims 1-51.

To reject claims 1-51 as obvious, the Office Action must establish that some combination of the cited base references and secondary references discloses all of the elements of claim 1-51 as set forth therein. The Office Action must also provide some teaching, suggestion, or motivation that would compel one of ordinary skill in the art to combine the base references and the secondary references. The Applicant respectfully submits that the Office Action fails to meet this burden and that claims 1-51 are allowable over the cited references.

Independent claim 1, as amended, defines a process for forming a substantially transparent, abrasion-resistant film from a film-forming composition containing surface-treated nanocrystalline particles dispersed in a cross-linkable resin. The process, among other steps, comprises "adding said surface-treated nanocrystalline particles to a cross-linkable resin to from a film forming composition, wherein the surface treated nanocrystalline particles are non-aggregating". Independent claim 18 defines a substantially transparent, abrasion-resistant film. Among other elements, the film comprises "a cross-linked resin and a plurality of surface-treated nanocrystalline particles dispersed in a non-aggregating fashion in said cross-linked resin..." Independent clams 26 and 26 recite similar features. The Applicant respectfully submits that the cited references do not disclose, either alone or in combination, all of the features of the independent claims.

<u>Havey et al. '514, '163</u> - Havey et al. '514 and Havey et al. '163 ("Havey") disclose a coating process and coating compositions derived from silica sol-gel precursors that contain from

.1 to 50 wt% colloidal silica. The coating compositions have from 10 to 99.9 wt% of a mixture of hydrolysis products and partial condensates of an epoxy functional silane and a tetra functional silane (these are silica sol-gel precursors) and from about .01 to about 30 wt% of a multifunctional compound selected from the group consisting of a multifunctional compound selected from the group consisting of multifunctional carboxylic acids, multifunctional anhydrides and combinations thereof. This coating has a water-organic solvent, is catalyzed, and needs a leveling aid to process uniform coating. The films disclosed by Havcy are transparent because of closely matched refractive indexes and not because particulate fillers arc dispersed in a non-aggregating state in a cross-linkable resin.

van Tao et al. '971 - van Tao et al. '971 ("Tao") discloses a process for producing coating compositions derived from UV-cured photopolymers that contain silica or alumina. The silica and/or alumina fillers are surface treated by grafting silanes to the surface of the fillers (col. 4, lines 62 – col. 5, line 22). Tao restricts the refractive index of the organic phase of the composition to that of the particles used. If the refractive index of the organic phase is not near that of the filler particles, the resulting film will not be transparent but rather translucent. The films disclosed by Tao are transparent because the filler and the resin have closely matched refractive indices – not because particulate fillers are dispersed in a non-aggregating state, in a cross linkable resin. Further, Nanocrystalline particles do not have enough surface functional groups to be surface treated by grafting silanes to the particle surface. Therefore, in addition to not teaching all of the elements of the claims, Tao is not compatible with any the sccondary references.

Nguyen et al. '656- Nguyen et al. ("Nguyen") discloses a process for surface treating silica or alumina. The surface treatment grafts silanes onto the surfacc of silica or alumina. This

type of surface treatment is not able to yield discrete particles – the resulting particle aggregation renders films that contain fillers, which do not have closely matched refractive indices, translucent or opaque. The films disclosed by Nguyen are transparent because the filler and the resin have closely matched refractive indices – not because particulate fillers are dispersed in a non-aggregating state, in a cross linkable resin. Further, Nanocrystalline particles do not have enough surface functional groups to be surface treated by grafting silanes to the particle surface. Therefore, in addition to not teaching the entirety of the independent claims, Nguyen is not compatible with any of the secondary references.

Brotzman et al. '967 and '781 -Brotzman et al. '967, '781 ("Brotzman") disclose a surface treating polymer and a process for making the polymer. Brotzman does not disclose all of the features of the claims (with the exception of nanoparticles). Therefore, even if the references were combined as the Office Action suggests, the claimed invention would not result.

In sum cited Havey, Tao, and Nguyen only teach making transparent films through refractive index matching, not through dispersing particulate fillers in a non-aggregating state. In fact, any abrasion resistance observable in these films is a result of large particle aggregates that would not yield transparent films without refractive index matching. Furthermore, as has been established, Tao and Nguyen are incompatible with the particles of the secondary references and thus teach away from any possible combination. Finally, Brotzman does not teach all of the features the Office Action attributes to it.

With respect to the secondary references, Penth '657 ("Penth") teaches neither the formation of transparent coatings (the nanoparticles would be aggregated by this process that includes a binder which would result in opaque films at micron thicknesses) nor the formation of abrasion resistant coatings. The coatings adhere to glass and metal (col. 2, line 14; col. 2, lines

23-24), and poor adhesion is observed on plastic substrates (col. 2, line 38). In fact, Penth claims the application of the ceramic coating on a porous substrate – this leads to good coating adhesion by virtue of mechanical interlocking. Lastly, the resulting coating layers are microporous (col. 2, line 43). Therefore, even if Penth were used to modify the base references, the combination would not result in nanoparticles dispersion in a non-aggregating state.

McCaulley et al. '830, '296 – McCaulley et al. ("McCaulley") discloses a thin coating applied to PET polymeric articles. The coating consists of metal polysilicate and titanium dioxide. The coating is a vapor, gas, and aroma barrier and has a refractive index that matches the refractive index of the PET. McCaulley teaches the incorporation of nanosized titania into a metal polysilicate coating to index-match a PET substrate and reduce thin film optical interference by reducing the reflectance at the coating/substrate interface (col. 5, lines 20-24). At coating thicknesses greater than 500 nm the coatings become opaque, even if the composition remains constant because the titania particles are not uniformly dispersed (see "milky white dispersions (col. 5, line 25)).

Thus, even if Penth and McCaulley were to disclose nanoparticles, the combination of the Penth and McCaulley is either not possible with the base references or would not disclose all of the features of the claims because particle aggregation would result. In fact, any abrasion resistance would be a result of large particle aggregates that would not yield transparent films. Therefore, the Applicant respectfully submits that none of the references, either alone or in combination, teach all of the claim elements.

Moreover, the Office Action fails to provide a suitable motivation for combining the references. The Office Action identifies six base references and three secondary references – 18 combinations – and yet only provides a single motivation for combining the references, i.e., it

would be obvious to one of ordinary skill in the art the combine the references as an obvious matter of design choice because nanoparticles are used for the same purpose as the claimed invention. Yet, as has been demonstrated above, the secondary references do not demonstrate that nanoparticles are used for the same purpose as the claimed invention, unless viewed in hindsight after reading the Applicant's disclosure.

The Office Action also fails to specifically identify the portions of the disclosure that the Examiner has relied upon to reject the claims. With 18 combinations of references, this is huge burden to place on an Applicant. Therefore, in the next Office Action, the Applicant respectfully requests that the Examiner please identify the portions of the references that the Examiner is relying upon.

The remaining claims are dependent. Since dependent claims include the features of the independent claims and intervening claims, the Applicant respectfully submits that the dependent claims are allowable for the same reasons as given with respect to the independent claims.

For all of the aforesaid, the Applicant respectfully submits that the present application is in condition for allowance. Favorable reconsideration is hereby requested.

Respectfully submitted,

Date: 2/11/03

By: [signature]
Douglas S. Rupert, Reg. No. 44,434

WILDMAN, HARROLD, ALLEN & DIXON
225 West Wacker Drive
Chicago, Illinois 60606
Ph: (312) 201-2000
Fax: (312) 201-2555

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of Roger Cayton et al.	)	SUBSTANTIALLY TRANSPARENT ABRASION-RESISTANT FILMS CONTAINING SURFACE-TREATED NANOCRYSTALLINE PARTICLES
Serial No.: 09/726,686	)	
Filed: November 29, 2000	)	Attorney Docket: 12951US01
	)	Group Art Unit: 1773
	)	Examiner: Leszek B. Kiliman

VERSION SHOWING MARKINGS TO AMENDED CLAIMS

1. (Amended) A process for forming a substantially transparent, abrasion-resistant film from a film-forming composition containing surface-treated nanocrystalline particles dispersed in a cross-linkable resin, the process comprising the steps of:

(a) adding nanocrystalline particles to a medium, said nanocrystalline particles being selected from the group consisting of ceramics and metals;

(b) mixing the nanocrystalline particles and medium to form a dispersion;

(c) adding a surface treatment solution to the nanocrystalline particle dispersion, said surface treatment solution comprising one or more siloxane species;

(d) mixing the nanocrystalline particle dispersion with the surface treatment solution such that said one or more siloxane species are disposed at the surface of at least some of said particles, whereby at least some surface-treated nanocrystalline particles are obtained;

(e) adding said surface-treated nanocrystalline particles to a cross-linkable resin to from a film forming composition, wherein the surface treated nanocrystalline particles are non-aggregating;

(f) applying said film-forming composition to a substrate;

(g) forming a substantially transparent abrasion-resistant film on said substrate from said film-forming composition.

4. (Amended) The process of claim 51~~1~~, wherein the nanocrystalline particle dispersion has a concentration of the nanocrystalline particles in the range of from about 5 percent by weight to about 40 percent by weight.

18. (Amended) A substantially transparent, abrasion-resistant film comprising a cross-linked resin and a plurality of surface-treated nanocrystalline particles dispersed in a non-aggregating fashion in said cross-linked resin, said surface-treated nanocrystalline particles comprising nanocrystalline particles and at least one siloxane species disposed at the surface of at least some of said particles, wherein said nanocrystalline particles are selected from the group consisting of ceramics and metals.

26. (Amended) A process for making a film-forming composition containing surface-treated nanocrystalline particles dispersed in a cross-linkable resin, said film-forming composition being suitable for forming a transparent, abrasion-resistant film, said process comprising the steps of:

(a) adding nanocrystalline particles to a medium, said nanocrystalline particles being selected from the group consisting of ceramics and metals;

(b) mixing the nanocrystalline particles and medium to form a dispersion;

(c) adding a surface treatment solution to the nanocrystalline particle dispersion, said surface treatment solution comprising at least one siloxane species;

(d) mixing the nanocrystalline particle dispersion with the surface treatment solution such that said at least on siloxane species is disposed at the surface of at least some of said plurality of particles, whereby surface- treated nanocrystalline particles are obtained;

(e) adding said surface-treated nanocrystalline particles to a cross-linkable resin, wherein the surface-treated nanocrystalline particles are non-aggregating, to form a film-forming composition; wherein a cross-linkable film-forming composition is formed.

44. (Amended) A film-forming composition comprising a cross-linkable resin and a plurality of surface-treated nanocrystalline particles dispersed in said cross-linkable resin in a non-aggregating fashion, said surface-treated nanocrystalline particles comprising nanocrystalline particles and at least one siloxane species disposed at the surface of at least some of said plurality of particles, wherein said nanocrystalline particles are selected from the group consisting of ceramics and metals.

50. (New) The process of claim 1, wherein the nanocrystalline particle dispersion has a concentration of the nanocrystalline particles in the range of from about .1 percent by weight to about 75 percent by weight.

51. (New) The process of claim 50, wherein the nanocrystalline particle dispersion has a concentration of the nanocrystalline particles in the range of from about 1 percent by weight to about 50 percent by weight.

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